

EXPANDED DISTRIBUTION OF *GRATIOLA QUARTERMANIAE*  
(PLANTAGINACEAE) IN TEXAS, U.S.A.

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ABSTRACT

Forty-nine new populations of *Gratiola quartermanniae* are reported from seven new counties in north central Texas. All populations were found on seasonally wet Walnut Limestone glades and are the first to be found in the Texas Grand Prairie and Limestone Cut Plain. These collections indicate that the species and its calcareous glade habitat are much more abundant in Texas than previously thought.

RESUMEN

Se citan cuarenta y nueve poblaciones nuevas de *Gratiola quartermanniae* de siete condados nuevos en el centro norte de Texas. Todas las poblaciones se encontraron en los claros estacionalmente húmedos de Walnut Limestone y son las primeras que se encuentran en la Grand Prairie de Texas y Limestone Cut Plain. Estas colecciones indican que la especie y su hábitat calcáreo son mucho más abundantes en Texas de lo que se creía previamente.

*Gratiola quartermanniae* D. Estes (Plantaginaceae) was first described from Eastern North America by Estes and Small in 2007. The species typically grows in thin, seasonally saturated soil over exposed limestone or dolomite bedrock (Estes & Small 2007; Taylor & Estes 2012). This habitat is typically found associated with limestone glades, barrens, prairies, and alvars. Estes and Small (2007) note that the species is most common in the limestone cedar glades of central Tennessee and northern Alabama, though it also occurs in primarily calcareous habitats in northeastern Illinois, central Texas, and southeastern Ontario. Similar disjunction patterns are seen in several other calciphilous species which grow in association with *G. quartermanniae* including *Clinopodium arkansanum* (Nutt.) House, *Grindelia lanceolata* Nutt., *Heliotropium tenellum* (Nutt.) Torr., *Isoetes butleri* Engelm., *Juncus filipendulus* Buckl., and *Minuartia patula* (Michx.) Mattf.

*Gratiola quartermanniae* is known from five collections in Texas (Fig. 1) including one each in Bell (Wolff 2317, SMU) and Llano (Whitehouse 18477, SMU, UC, US) counties, and three in Williamson County (Bodin s.n., PH, MIN; Turner & Turner 122, BRIT, MO, TENN, TEX; Turner & Turner 119, BRIT, GH, MO, TENN, TEX). While the label data do not indicate the exact location of each site, the Williamson and Bell county specimens appear to occur in calcareous habitats, which is typical for the taxon. The Llano County site appears to be an exception, apparently occurring on granite.

In 2007, O'Kennon discovered a population of what he later determined to be *Gratiola quartermanniae* from a calcareous Walnut Limestone glade seep in Wise County, Texas (O'Kennon 20515B, BRIT). This represents the first documented population for *G. quartermanniae* in north central Texas, a disjunction of approximately 230 km to the north of the populations in central Texas. Despite the large disjunction, the occurrence of *G. quartermanniae* in the Grand Prairie is not surprising. The predominately Cretaceous limestone substrate that comprises the Edwards Plateau extends northward through the Limestone Cut Plain (Lampasas) and Grand Prairie (Griffith et al. 2004). With these large extensions of similar, and in some cases identical, substrate it is not surprising that we find calciphilous species with distributions extending farther to the north than previously thought (Swadek & Burgess 2012; Taylor et. al 2012; Taylor & O'Kennon 2012).

In the spring of 2012, the authors conducted extensive surveys of limestone prairies, barrens, and glades in the Grand Prairie and northern Limestone Cut Plain of north central Texas. Areas where limestone outcrops form "glades" reminiscent of the cedar glades found in the Central Basin of Tennessee were searched for *G.*

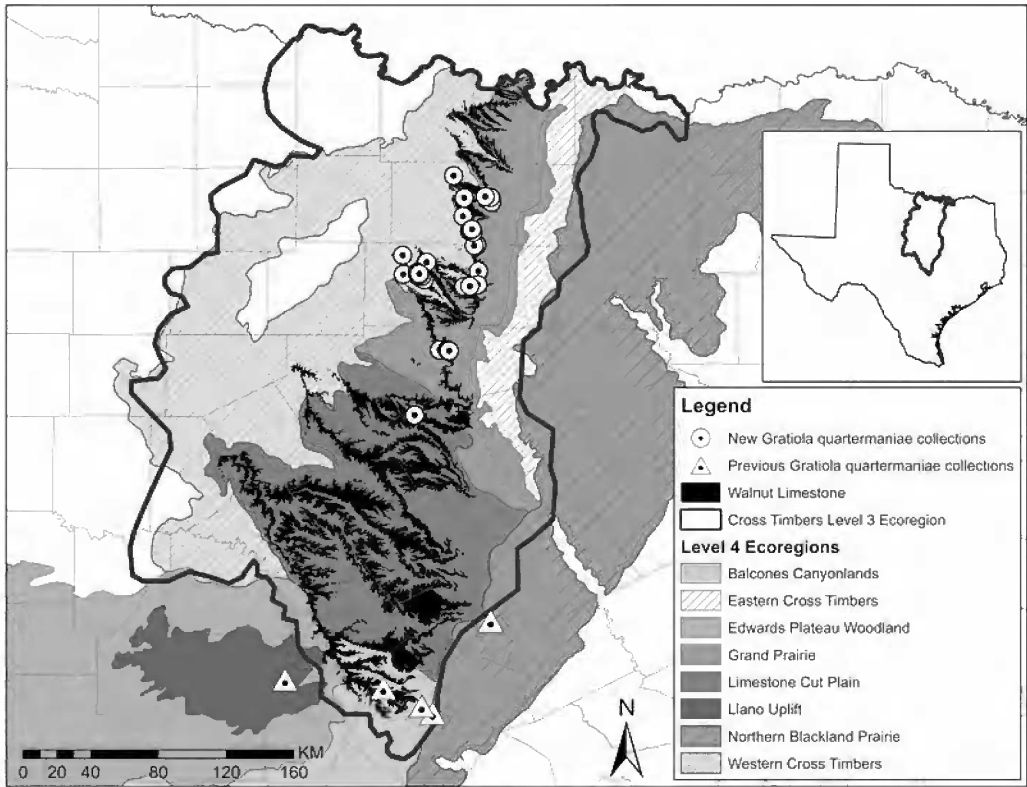


FIG. 1. Documented collection sites of *Gratiola quartermanniae* in Texas. Forty-nine previously unknown sites were documented in 2012 from Walnut Limestone glade seeps on the western edge of the Grand Prairie and the northern Limestone Cut Plain (McGowen et al. 1987; McGowen et al. 1991; Griffith et al. 2004).

*quartermanniae*. Satellite imagery and geologic maps were used to identify other possible locations for exploration. During this search, 49 new locales were identified for *G. quartermanniae*. These collections represent 7 new county records, including Bosque, Denton, Hood, Johnson, Parker, Tarrant, and Wise counties (Fig. 1). At least one voucher specimen from each county was collected and deposited at BRIT. Specific collection information for each specimen is available online at [atrium.brit.org](http://atrium.brit.org).

All sites in north central Texas are underlain by Walnut Limestone substrate. This Cretaceous, fossiliferous, erosion resistant limestone forms glades when exposed. In the Grand Prairie these glades form at lower topographic positions as the overlying substrate erodes (Fig. 2). In the Limestone Cut Plain, Walnut Limestone glades are found encircling the Edwards or Comanche Peak Limestone mesas that characterize the region (Hill 1901). Seepage from the interbedded limestone and marl layers upslope will often form shallow pools or streams over exposed Walnut bedrock at the base of the slopes (Swadek & Burgess 2012).

*Gratiola quartermanniae* was found in very shallow soil directly over limestone bedrock on the edges and on small soil islands in limestone bedrock creeks and seeps, or in deeper, mucky limestone soil in disturbed sites including highly grazed cattle ponds (Fig. 3). *Gratiola quartermanniae* is most abundant in areas with little competing vegetation or in areas with high levels of disturbance.

The majority of the sites were found on relatively undisturbed, seasonally saturated seeps and streambeds with little to no soil accumulation and large amounts of exposed limestone bedrock (Fig. 3). The remaining sites were found in deeper soils over Walnut Limestone but were highly disturbed. Most deeper soil sites were

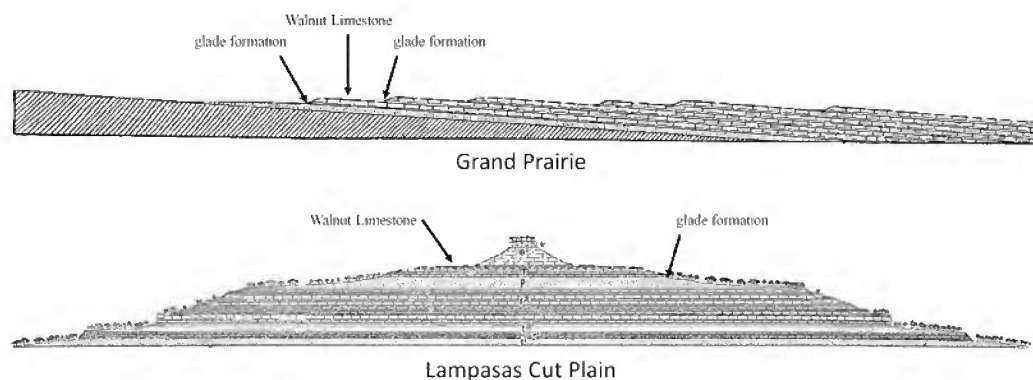


Fig. 2. Diagrammatic section of Grand Prairie (top) and Limestone (Lampasas) Cut Plain (bottom), showing position of Walnut Limestone outcrops across the landscape. In the Grand Prairie Walnut Limestone glades form when Walnut Limestone bedrock is exposed. In the Lampasas Cut Plain glades are found near the base of the many mesas throughout the region. Diagrams modified from Figures 3 and 5 by Hill (1901).

heavily grazed by livestock and were highly trampled. We believe this high level of disturbance eliminates competitors allowing *G. quartermaniae* to persist in the deeper soils. Most populations were small and isolated with fewer than 50 plants, though a few sites had well over 500 plants. Associated species include *Eleocharis occulta* S.G. Sm., *Hypoxis hirsuta* (L.) Coville, *Spiranthes magnicamporum* Sheviak, *Isoetes butleri* Engelm., *Nothoscordum bivalve* (L.) Britton, *Allium canadense* L. var. *fraseri* Ownbey, *Juncus filipendulus* Buckl., *Fuirena simplex* Vahl var. *simplex*, and *Leucospora multifida* (Michx.) Nutt.

Plants flower from late March through May, and set seed from April through early June. The plant dries and disappears completely by early summer. This phenology closely matches the hydrological regime of the limestone glades where the species is found. Saturated conditions in the spring give rise to near drought-like conditions in the summer and fall as temperatures rise and rainfall decreases. *Gratiola quartermaniae* appears to be specifically adapted to complete its life cycle within this narrow hydrological window.

*Gratiola quartermaniae* is much more widespread in Texas than previously thought. This oversight can be attributed to the short lifecycle of the species and the lack of thorough botanical exploration in the limestone prairies of north central Texas. Until recently, the limestone glade habitat, which is prolific on the western edge of the Grand Prairie, remained relatively unexplored botanically. This is evident by the recent discovery or range expansion of several species characteristic of glades in the region, including *Isoetes butleri* (Taylor et. al 2012), *Phemeranthus calcaricus* (Engelm.) Kiger (Swadek 2012), and *Dalea reverchonii* (S. Wats.) Shinnery (Taylor & O'Kennon 2012). Additional exploration of the Grand Prairie and Limestone Cut Plain regions of Texas would likely reveal the presence of additional glade taxa and more locations for *G. quartermaniae*. In particular, the Walnut Limestone formation is quite extensive in the Limestone Cut Plain and warrants further exploration.

Representative Voucher Specimens.—**U.S.A. TEXAS. Bosque Co.:** Co Rd 2650 ca. 0.7 mi SE of Co Rd 2660, ca. 3.5 air mi NW of Walnut Springs. 32.087772N, -97.795782W, elev 297 m, abundant along ephemeral glade stream, 27 Apr 2012, Norton & O'Kennon 1673 (BRIT). **Denton Co.:** N County Line Rd ca. 0.25 mi S of Hwy 380, ca. 70 m E, Walnut Limestone seep glade, 33.242092N, -97.38987W, elev 226 m, 21 Apr 2012, O'Kennon 24963 (BRIT). **Hood Co.:** Running Deer Ct ca. 0.8 mi N Cleburne Hwy, Walnut Limestone glade, 32.433357N, -97.621662W, elev 229 m, 27 Apr 2012, Norton & O'Kennon 1676 (BRIT). **Johnson Co.:** Running Deer Ct at Cleburne Hwy, Walnut Limestone glade, 32.427675N, -97.615694W, elev 240 m, 27 Apr 2012, Norton & O'Kennon 1675 (BRIT). **Parker Co.:** Old Agnes Rd ca. 0.1 mi N of Louis Scherer Rd on E side of rd, 32.846977N, -97.778998W, elev 355 m, growing in thin soil over Walnut Limestone bedrock, seasonally wet, abundant, 10 Apr 2012, Norton & O'Kennon 1525 (BRIT). **Tarrant Co.:** White Settlement, Verna Trail N ca. 0.2 mi N of Stubbs Trail, 32.77301N, -97.5015W, elev 216 m, growing in ephemeral swale over Walnut Limestone, 13 Apr 2012, Norton & O'Kennon 1548 (BRIT). **Wise Co.:** Hwy 114 ca. 0.6 mi W of hwy 81 at Rhome. N side of rd, 33.060325N, -97.488865W, elev 247 m, seasonally wet seepage area below pond dam, thin soil over Walnut Limestone bedrock, growing with *Isoetes butleri*, *Fuirena simplex*, and *Leucospora multifida*, 13 May 2007, O'Kennon 20515B (BRIT); 8 May 2012, Norton & O'Kennon 1689 (BRIT).





FIG. 3. Ephemeral limestone seep with exposed Walnut Limestone bedrock, Denton Co. (O'Kennon 24971, BRIT) (top); *Gratiola quartermaniae* growing in shallow soil overtop exposed bedrock, Wise Co. (Norton & O'Kennon 1539, BRIT) (left); close up of *G. quartermaniae*, Parker Co. (Norton & O'Kennon 1511, BRIT) (right).

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